



Columbia College
in the City of New York

PART VII

SCHOOL OF PURE SCIENCE

CIRCULAR OF INFORMATION

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TRUSTEES OF COLUMBIA COLLEGE

NAMES	RESIDENCES
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WILLIAM C. SCHERMERHORN.....	49 West 23d Street
MORGAN DIX, S.T.D., D.C.L.....	27 West 25th Street
SAMUEL BLATCHFORD, LL.D.....	Washington, D. C.
STEPHEN P. NASH, LL.D.....	11 West 19th Street
JOSEPH W. HARPER.....	562 Fifth Avenue
CHARLES A. SILLIMAN.....	25 Whitehall Street
FREDERICK A. SCHERMERHORN.....	61 University Place
GERARD BEEKMAN.....	5 East 34th Street
ABRAM N. LITTLEJOHN, D.D., LL.D. (Cantab.)..	Garden City, L. I.
EDWARD MITCHELL.....	31 East 50th Street
W. BAYARD CUTTING.....	18 West 57th Street
TALBOT W. CHAMBERS, S.T.D.....	70 West 36th Street
SETH LOW, LL.D.....	30 East 64th Street
GEORGE L. RIVES.....	14 West 38th Street
LENOX SMITH.....	120 Broadway
JOHN CROSBY BROWN.....	36 East 37th Street
HENRY C. POTTER, D.D., LL.D. (Cantab.)...	160 West 59th Street
WILLIAM H. DRAPER, M.D.....	19 East 47th Street
MARVIN R. VINCENT, S.T.D.....	136 East 37th Street
JOHN B. PINE, <i>Clerk of the Board</i>	67 Wall Street
CORNELIUS VANDERBILT.....	1 West 57th Street
GEORGE G. WHEELOCK, M.D.....	75 Park Avenue
FREDERIC R. COUDERT, LL.D.....	15 East 45th Street

JOHN MCLEAN NASH, *Treasurer*.....67 Wall Street

SCHOOL OF PURE SCIENCE

UNIVERSITY FACULTY OF PURE SCIENCE

NAMES	RESIDENCES
SETH LOW, LL.D.....	30 East 64th St. President of Columbia College
THOMAS EGLESTON, E. M., Ph.D., LL.D....	35 W. Washington Sq. Professor of Mineralogy and Metallurgy
CHARLES F. CHANDLER, Ph.D., M.D., LL.D....	51 East 54th St. Professor of Chemistry
J. HOWARD VAN AMRINGE, Ph.D., L.H.D.....	66 West 47th St. Professor of Mathematics
OGDEN N. ROOD, A.M.....	41 East 49th St. Professor of Physics
JOHN K. REES, A.M., E.M.....	"The Dakota," 1 West 72d St. Professor of Astronomy, and Director of the Observatory
JOHN G. CURTIS, A.M., M.D.....	127 East 35th St. Professor of Physiology
NATHANIEL L. BRITTON, E.M., Ph.D.....	41 East 49th St. Professor of Botany and Secretary of the Faculty
JAMES F. KEMP, A.B., E.M.....	41 East 49th St. Professor of Geology
MICHAEL I. PUPIN, Ph.D.....	46 West 72d St. Adjunct Professor of Mechanics
HENRY FAIRFIELD OSBORN, Sc.D.....	850 Madison Ave. Da Costa Professor of Biology and Dean of the Faculty
EDMUND B. WILSON, Ph.D.....	41 East 49th St. Adjunct Professor of Biology
WM. HALLOCK, A.B., Ph.D.....	428 Central Park West. Adjunct Professor of Physics
ALFRED J. MOSES, E.M., Ph.D.....	9 Henderson Pl. Adjunct Professor of Mineralogy

OTHER OFFICERS

ELWYN WALLER, A.M., E.M., Ph.D.....	43 West 15th St.
Professor of Analytical Chemistry	
CHARLES E. COLBY, E.M., C.E.....	1933 Madison Ave.
Adjunct Professor of Organic Chemistry	
CHARLES E. PELLEW, E.M.....	68 East 54th St.
Demonstrator of Chemistry and Physics	
FREDERIC S. LEE, Ph.D.....	3 East 47th St.
Demonstrator of Physiology	
JAMES S. C. WELLS, Ph.D.....	Box 29, Hackensack, N. J.
Instructor in Qualitative Analysis	
FERDINAND G. WIECHMANN, Ph.D.....	41 East 49th St.
Instructor in Chemical Philosophy and Chemical Physics	
THOMAS S. FISKE, A.M., Ph.D.....	104 West 69th St.
Instructor in Mathematics	
HAROLD JACOBY, A.B.....	15 West 53d St.
Instructor in Astronomy	
HOLBROOK CUSHMAN, A.B.....	337 West 22d St.
Instructor in Physics	
BASHFORD DEAN, Ph.D.....	41 East 49th St.
Instructor in Biology	
LOUIS H. LAUDY, Ph.D.....	41 East 49th St.
Tutor in General Chemistry	
HENRY C. BOWEN.....	212 East 50th St.
Tutor in Quantitative Analysis	
J. C. PFISTER, A.B.....	Newark, N. J.
Tutor in Mechanics	
LEA MCL. LUQUER, C.E.....	41 East 49th St.
Tutor in Mineralogy	
JAMES MACLAY, C.E.....	Newark, N. J.
Tutor in Mathematics	
REGINALD GORDON, A.B.....	76 Park Ave.
Tutor in Physics	
JOSEPH T. MONELL, E.M., E.E.....	236 West 22d St.
Tutor in Astronomy	
ARTHUR WILLEY.....	41 East 49th St.
Tutor in Biology	
HERMANN T. VULTÉ, Ph.D.....	41 East 49th St.
Assistant in Quantitative Analysis	

CHARLES A. HOLLICK, Ph.B.....	New Brighton, S. I.
Assistant in Geology	
HERSCHEL C. PARKER, Ph.B....	21 Ft. Green Pl., Brooklyn, N. Y.
Assistant in Physics	
ALEXANDER R. CUSHMAN, Ph.D.....	128 East 16th St.
Assistant in Chemistry (Qualitative Analysis)	
DELANCEY W. Ward, Ph.B.	41 East 49th St.
Assistant in Organic Chemistry	
ASA S. IGLEHART, A.B.....	106 East 86th St.
Assistant in Physics	
HERBERT P. WHITLOCK, C.E.....	41 East 49th St.
Assistant in Mineralogy	
CHARLES C. TROWBRIDGE, Ph.D.....	41 East 49th St.
Assistant in Physics	
JOSEPH A. DEGHIÉE, Ph.B.....	437 West 59th St.
Assistant Demonstrator of Chemistry and Physics	
HENRY S. CURTIS, A.B.....	Buckingham Hotel
Assistant in Mathematics	
CLIFTON N. WINDECKER, C.E.....	41 East 49th St.
Assistant in Mathematics	
CARLTON C. CURTISS, A.M.....	41 East 49th St.
Assistant in Botany	
THOMAS MORONG, A.M., Ph.D.....	41 East 49th St.
Curator of the Herbarium	

DELEGATES TO THE UNIVERSITY COUNCIL

THE DEAN, Professor OSBORN

Professor REES



NOTE : Mr. R. S. WOODWARD, C.E., has been elected Professor of Mechanics, to take effect July 1, 1893.

GENERAL STATEMENT

In the Faculty of Pure Science are represented all the departments of the University in which instruction is given in courses leading to the higher degrees in Pure Science, namely :

DEPARTMENTS	HEADS OF DEPARTMENTS
Mathematics	Prof. Van Amringe
Mechanics	Prof. Woodward
Physics	Prof. Rood
Chemistry, Organic and Inorganic . .	Prof. Chandler
Mineralogy	Prof. Egleston
Astronomy	Prof. Rees
Geology, Lithology, and Palæontology .	Prof. Kemp
Biology (Zoölogy)	Prof. Osborn
Botany	Prof. Britton
Physiology	Prof. Curtis

This Faculty has in charge the supervision of all candidates for the degrees of A.M. or Ph.D., in any of the branches of Pure Science taught in the University. Students taking their major subject in Pure Science will be regarded as under the especial supervision of this Faculty. Students taking one minor subject, or both, and special students must also register with the Dean.

Candidates for the degrees of A.M. or Ph.D. are subject :

- 1st. To the general regulations of the University Council.
- 2d. To the special regulations of this Faculty.

The standard of preparation for admission to major and minor courses is indicated by the courses marked "collegiate" under each department. These, or their equivalents, will be required by examination or otherwise, according to the previous collegiate record of the candidate.

Students of this and other colleges whose requirements conform to the regulations of the School of Arts may be admitted to

the Senior courses under this Faculty as candidates for the degree of A.B. They must present testimonials from some other institution maintaining an equivalent course of study, to the close of the Junior year or must pass a satisfactory examination upon the studies of the first three years of the School of Arts. Candidates for this degree are required to pursue courses of instruction amounting in all to not less than fifteen hours of attendance per week for one year, and must conform to such requirements regarding a thesis as are established for members of the Senior class in the School of Arts. Their selection of studies is not confined to those in this Faculty.

A synopsis of the Pure Science courses now offered in the University is given upon pages 12-35.

University Fellowships

Twenty-four University fellowships have been established, tenable for one year, with a possibility of reappointment for two successive years for reasons of weight. Applications for fellowships should be addressed to the President of Columbia College. By the advice of the University Council the following rules have been adopted regarding the fellowships :

1 The application shall be made prior to March 1st, in writing, addressed to the President of Columbia College. Applications received later than March 1st may fail of consideration. The term of the fellowship is one year, dating from July 1st. Residence should begin October 1st.

2 The candidate must give evidence

(a) of a liberal education, such as a diploma already granted, or about to be received, from a college or scientific school of good repute ;

(b) of decided fitness for a special line of study, such as an example of some scientific or literary work already performed ;

(c) of upright character, such as a testimonial from some instructor.

3 The value of each fellowship is five hundred dollars. Payments will be based on the time during which the fellow shall have been in residence. The holder of a fellowship is exempt from the charges for tuition.

4 Every holder of a fellowship will be expected to perform such duties as may be allotted to him in connection with his course of study, which course will be such as to lead to the degree of Doctor of Philosophy. He will be expected to devote his time to the prosecution of special studies under the direction of the head of the department to which he belongs, and before the close of the academic year to give evidence of progress by the preparation of a thesis, the completion of a research, the delivery of a lecture, or by some other method. He must reside in New York or vicinity during the academic year.

5 No holder of a fellowship shall be permitted to pursue a profession or technical course of study during his term. With the written approval of the President, but not otherwise, he may give instruction or assistance in any department of the University.

6 No fellow shall be allowed to accept remunerative employment except by written permission of the President, and the acceptance of any such employment, without such permission, shall operate to vacate the fellowship.

7 A fellow may be reappointed at the end of the year for reason of weight. No fellow may be reappointed for more than two terms of one year each.

8 As these fellowships are awarded as honors, those who are disposed, for the benefit of others or for any other reason, to waive the pecuniary emolument, may do so, and still have their names retained on the list of fellows.

John Tyndall Fellowship

There is also a fellowship known as the "John Tyndall Fellowship for the Encouragement of Research in Physics," which is awarded to some suitable person, either a graduate of or a student in the college, but not necessarily a candidate for a degree. Such fellow is appointed by the Council upon the recommendation of the head of the Department of Physics. The appointment is for the term of one year only, but the fellow, for the time being, is eligible for appointment from year to year upon like recommendation. The fellow so appointed is entitled to receive during his term of office the net income of the capital sum constituting the endowment, to be paid in four quarterly install-

ments on the usual quarter days, upon the certificate of the President; and the Trustees guarantee that such net income will amount to at least six hundred and forty-eight dollars a year, being six per cent. upon ten thousand eight hundred dollars, the fund presented to the college by Professor Tyndall.

Regulations

For the Degrees of Master of Arts and Doctor of Philosophy, Established by the University Council

1 Any student who has taken his baccalaureate degree either in Columbia College or in some other college maintaining an equivalent curriculum (every such case of equivalence to be considered on its own merits) shall be entitled, with the approval of the President, to become a candidate for the degrees of Master of Arts and Doctor of Philosophy, or either of them.

2 Each student who declares himself a candidate for the degrees of Master of Arts and Doctor of Philosophy, or either of them, shall, immediately upon registration, designate one principal or major subject and two subordinate or minor subjects, which, when approved by the proper Faculty, shall be the studies of his University course. Should the subjects designated by the candidate fall within the jurisdiction of more than one University Faculty, the candidate's selection must receive the sanction of the President before it is recorded.

3 Candidates for the degrees of Master of Arts and Doctor of Philosophy, or either of them, must pursue their studies under the direction of the professors and other officers of instruction in charge of the subjects selected by the candidates as major and minor, attending such lectures as may be designated, and performing faithfully such other work in connection therewith as may from time to time be prescribed.

4 Students desiring to be examined as candidates for any degree must make written application for such examination to the Dean of the proper Faculty, on blank forms provided for the purpose.

5 Each candidate for the degree of Master of Arts, in addition to passing satisfactory examinations on prescribed portions of the subjects selected by him as major and minor, shall present an essay on some topic previously approved by the professor in charge

of his major subject. Before the candidate is admitted to examination, the professor in charge of his major subject must have signified his approval of such essay.

6 Each candidate for the degree of Doctor of Philosophy, in addition to passing satisfactory examinations on the subjects selected by him as major and minor, shall present a dissertation, embodying the result of original investigation and research, on some topic previously approved by the Faculty. When such dissertation has been approved by the Faculty, it shall be printed by the candidate and one hundred and fifty copies shall be delivered to the Faculty. On the title-page of every such dissertation shall be printed the words: "Submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy, in the University Faculty of ———— Columbia College." There shall be appended to each dissertation a statement of the educational institutions that the author has attended, a list of the degrees and honors conferred upon him, as well as the titles of any previous publications.

7 Every candidate for the degree of Doctor of Philosophy, in addition to passing such other examinations as may be required by the Faculty, shall be subjected to an oral examination on his major subject and shall defend his dissertation, in the presence of the entire Faculty or of so many of its members as may desire to attend. The ability to read at sight two or all of the following languages—Latin, French, and German,—as each Faculty may determine, will also be required.

Special Regulations of the Faculty of Pure Science

As a general rule no course allowed for the degree of A.B. in the School of Arts shall be considered either as major or minor preparation for the degree of A.M. or Ph.D. (This does not exempt courses intended primarily for graduates, but open to properly qualified Seniors, and indicated by an asterisk in the announcements of the departments.)

Graduates of the School of Mines shall select their courses upon the same principle—that no undergraduate courses will be considered either major or minor subjects.

Undergraduate or collegiate courses are considered preparatory to admission to the University courses.

Every candidate for the degree of Doctor of Philosophy shall be required to read at sight French and German.

SUBJECTS.—No two subjects shall be chosen from the same department without the consent of the Faculty.

ESSAY.—For the degree of Master of Arts, the power to approve the subject chosen for his essay by any candidate, as well as the power to approve the essay itself, shall be delegated to the instructor in charge of the candidate's major subject.

DISSERTATION.—For the degree of Doctor of Philosophy, the power to approve the subject chosen for his dissertation by any candidate, as well as the power to approve of the dissertation itself, shall be delegated to the instructor in charge of the candidate's major subject. Dissertations shall be submitted by the third week in March. They shall be printed in the size and form either of the "Annals" or "Memoirs" of the New York Academy of Sciences, according to the nature of the subject, and must be delivered to the Faculty before the final examination.

Examination

Applications to be examined for the degree of Master of Arts or Doctor of Philosophy must be made on or before April 1st of the academic year in which the examination is desired. The examination shall be oral, at least in part, and in the case of candidates for the degree of Doctor of Philosophy the dissertation must be publicly defended in the presence of the Faculty or of so many of the members as may desire to attend. The instructors in charge of the major and minor subjects must be present and conduct the examination.

RECORD.—At the close of each course the instructor in charge shall enter in the registration book the record of the student, and at the close of each Academic year each student shall exhibit his registration book to the Dean or Secretary for record.

TIME.—At least one year's study is required for the degree of Master of Arts, and at least two years' study for the degree of Doctor of Philosophy.

Special Students

Students who are not candidates for a degree shall be permitted to pursue such courses from among those offered by this

Faculty as they may be found qualified to enter upon and as the Dean may approve.

Qualifications of such students shall be passed upon by the instructors in charge of the courses selected by them. The standard will conform in general to that required of candidates for degrees.

All applications to pursue courses of study either wholly or in part under the direction of this Faculty shall be made in writing to the Dean, on blank forms prepared for the purpose.

Admission

Every student, on first entering Columbia College, is required to pay a matriculation fee of \$5, and to sign the matriculation book in the office of the President, as an indication of his willingness to be bound by the rules and regulations adopted for the government of students, either by the Trustees or by the Faculty.

After matriculation in the President's office, the student shall register in the office of the Dean of this Faculty, and enter in his registration book the courses he desires to pursue. This selection of courses will be subject to the approval of the Dean. His application will then be referred to the head of each department concerned, and upon approval of his qualifications for the courses selected, he will be recorded as a student under this Faculty.

Fees

The following fees are established by the Trustees :

For candidates for the degree of Bachelor	
of Arts in the School of Pure Science	per annum \$200
For candidates for the degree of Master of	
Arts and Doctor of Philosophy	do 150
For students pursuing partial courses,	
at the rate of \$15 per annum for each hour of at-	
tendance per week of lectures or recitations, with a	
maximum fee of	150
For auditors,	
at the rate of \$20 per annum for each hour of attend-	
ance per week on lectures or recitations, with a maxi-	
mum fee of	200

For Examinations :

For examinations at unusual times	\$ 5
For the Bachelor's degree (not professional or technical)	15
For any professional or technical degree	25
For the degree of Master of Arts	25
For the degree of Doctor of Philosophy	35

Payment of Fees

Candidates for a degree, after filling in the blank provided at the office of the Registrar for the purpose, will present the same to the Treasurer, with the proper fee. Students entering the University for the first time are required to pay a matriculation fee, and to matriculate in the President's office by writing their names in the matriculation book. Such students must personally present the Treasurer's receipt for all required fees upon the form provided, as evidence of their right to matriculate.

At the beginning of each academic year every student is required to procure a matriculation card from the office of the President. Students who have matriculated in a previous year will, after paying their fees and obtaining the Treasurer's receipt, place such receipt in the envelope provided for the purpose, addressed to the President's Secretary, and deposit the same in the President's letter-box. The matriculation card will be sent to the student by mail as promptly as possible.

Immediately after receiving his matriculation card, every student must present the same to the Dean for registration. No student is permitted to attend any academic exercise, nor will he be given any credit for the same, until he has complied with the regulations in regard to matriculation and registration. The matriculation card must be carefully preserved by the student, and must not be folded or rolled.

Students intending to pursue a partial course, after filling in the blank provided at the office of the Registrar for the purpose, and before presenting the same to the Treasurer, must have the amount of the tuition fee certified by the Dean. No fee for a partial course will be received without such certification. After due certification the blank should be presented to the Treasurer with the proper fee, after which the student will matriculate and register as directed above.

Free and Reduced Tuition

No student is granted free or reduced tuition during the first year of his connection with the college. At any time thereafter, however, he may make application to the Faculty to have his tuition fee remitted in whole or in part. The Faculty is empowered to act favorably on a limited number of such applications from students whose record in the college entitles them to special consideration.

Students who are permitted, under the provisions of the foregoing paragraph, to enjoy the privilege of free or reduced tuition are not exempt from the payment of the fee fixed for special examinations held at unusual times, or from the fees fixed for the final examinations for degrees.

Every student receiving the benefit of free or reduced tuition is required to file with the President's Secretary a certificate to that effect from the Dean.

COURSES OF STUDY

Department of Mathematics

Collegiate Courses

- I *Analytical Geometry*—Three hours a week during the Junior year
- II *General Theory of Equations*—Two hours a week during the Junior year
- III *Advanced Solid Analytic Geometry and Higher Plane Curves*—Three times a week during the Senior year (intended primarily for university students)
- IV *Differential and Integral Calculus*—Three hours a week during the Senior year

University Courses

For Candidates for the Degree of A.M. or Ph.D., or both

- V *Advanced Differential and Integral Calculus*—Three hours a week throughout the year

VI	<i>General Differential Equations</i> —3 hours a week for 1 term		
VII	<i>Theory of Invariants</i> ,	"	"
VIII	<i>Theory of Substitutions</i> ,	"	"
IX	<i>General Theory of Functions</i> ,	"	"
X	<i>Elliptic Functions</i> ,	"	"
XI	<i>Abelian Functions</i> ,	"	"
XII	<i>Projective Geometry</i> ,	"	"
XIII	<i>Theory of Surfaces</i> ,	"	"

Professor VAN AMRINGE, Dr. FISKE, and Mr. MACLAY

MINOR : Any course requiring three hours a week throughout the year, or any combination of courses requiring three hours a week throughout the year, may be taken as a Minor, subject to the approval of the Professor of Mathematics

MAJOR : Any courses or combination of courses requiring six hours a week throughout the year may be taken as a Major, subject to the approval of the Professor of Mathematics

Department of Mechanics

Collegiate Courses

- I *Elementary Mechanics*—Two hours per week for two terms ; Junior Elective in School of Arts
Professor WOODWARD

University Courses

- II *Analytical Mechanics*—Three hours per week for two terms. Required of the Third-year School of Mines students
Professor WOODWARD
- III *Elementary Thermodynamics*—Two hours per week for two terms. Text-book : Maxwell's Heat
Professor PUPIN

These courses can be selected as Minor courses for the Ph.D. or the A.M. degree. Three to four hours a week constitutes a Minor course

- IV *Advanced Analytical Mechanics*, including the Theory of the Newtonian Potential. Two hours per week for two terms
Professor WOODWARD

- V *Hydrodynamics*—Two hours per week for one term
Professor WOODWARD
- VI *Theory of Electricity*—Third-year course in the Department of Electrical Engineering. Three hours per week for two terms
Professor PUPIN
- VII *Theory of Electricity*—Fourth-year course in the Department of Electrical Engineering. Three hours per week for two terms
Professor PUPIN
- VIII *Application of Generalized Dynamical Principles to Heat and Electricity*—Two hours per week for one term
Professor PUPIN
- IX *Thermodynamics and Some of its Applications*—Fourth-year course in the School of Mines. Two hours per week for one term
Professor PUPIN
- X *On Electrical Oscillations and High Frequency Currents*—Lectures and experimental work
Professor PUPIN

These courses are offered as Major courses for the Ph.D. or the A.M. degree. They will be arranged in such a way that the candidates may attend from six to nine lectures a week during every term. Courses in Experimental Physics and Mathematics are recommended as Minors. Six to nine hours per week is equivalent to a full Major course

Department of Physics

Collegiate Courses

- I *General Physics*—Sound and Heat (First Term). Light and Electricity (Second Term). Open to School of Mines First-year students and to Seniors, School of Arts. Lectures and recitations, three hours per week
Professor ROOD and Mr. GORDON.
- II *Sound* (First Term)—*Magnetism and Electricity* (Second Term)—Four hours per week, two hours' lectures, two hours' laboratory work. Open to Juniors, School of Arts. Text-book : Atkinson's Ganot
Professor ROOD.

University Courses

- III *Electricity* (First Term)—Lectures on absolute system of mechanical and electrical units; electrical measurements; the derivation and use of the Ampere, Volt, Ohm, Watt & Joule

Exact Physical Measurements in Laboratory. (Second Term)—Lectures on the Farad., Coulomb., and units of electric and magnetic induction; electrical and magnetic measurements in the laboratory

Lectures two hours per week, laboratory six hours per week. Open to Third-year Class, School of Mines. Text-books: Everett's, C. G. S., System of Units, Glazebrook and Shaw's Physics, Kohlrausch's Physical Measurements, Wiedemann and Eberts' Physics, and A. Witz's Physics

Professor HALLOCK

- IV *Light* (First Term)—Lectures on the velocity, reflection, refraction, and dispersion of light. Achromatism, optical instruments, the eye and Young's theory of color. Physical measurements in the laboratory

Heat (Second Term)—Lectures on the expansion of solids, liquids, and gases; on conduction, specific heat, tension of vapors, and radiant heat. Physical measurements in laboratory

Lectures three hours per week, laboratory four hours. Open to properly qualified Seniors, School of Arts. Text-books: Stewart and Gee, and Glazebrook and Shaw's Physics, also Worthington's Physical Laboratory Practice

Professor ROOD

- V *Sound* (First Term)—Lectures on the velocity, reflection, refraction, and interference of sound; on vibrating strings and rods; organ pipes, the voice, ear, and telephone. Physical measurements in the laboratory

Electricity (Second Term)—Lectures on frictional and voltaic electricity; magnetism, electrical conduction and induction. Physical measurements in the laboratory.

Lectures two hours, laboratory work six hours per week. Open to properly qualified Juniors, School of Arts. Text-books: Atkinson's Ganot and Stewart and Gee's Physics

Professor ROOD

Laboratory Courses*Minor Courses, First Year*

- VI Electromotive force of standard and constant cells
- VII Study of strength of electric currents
- VIII Study of elasticity of solid bodies
- IX Colorimetry, and absorption spectra
- X Photometry

Minor Courses, Second Year

- XI Hypsometry
- XII Determination of index of refraction by special methods
- XIII Study of diamagnetism
- XIV Quantitative examination of the discharge of the induction coil
- XV Viscosity of solids

Major Courses, First Year

- XVI Calorimetry
- XVII Radiant heat
- XVIII Interference of light
- XIX Polarized light
- XX Acoustic measurements
- XXI Thermo-electricity
- XXII Electrical induction
- XXIII Electrical conduction
- XXIV Electrical insulation

Professors ROOD and HALLOCK, Mr. CUSHMAN, and Mr. GORDON

Department of Chemistry**Collegiate Courses**

- I *General Inorganic Chemistry*—Introduction. Laws of chemical combination. History, occurrence, preparation, and properties of the elements and their principal compounds. Two lectures and one recitation per week throughout the year. Required of School of Mines First-year students in all courses. Open to Sophomores, Juniors, and Seniors in School of Arts. Text-book : Fowne's Manual of Chemistry. Professor CHANDLER and Mr. WARD

- II *Physics and General Chemistry*—Four lectures per week throughout the year. Required of First- and Second-year students in the School of Medicine. Open to Seniors in the School of Arts
Professor CHANDLER
- III *Physiological Chemistry*—Including the preparation and properties of the chief constituents of plants and animals. This course is given twice a year, and consists of two lectures and two afternoons in the laboratory each week for one half the year. Text-book, Pellew's Manual of Medical and Physiological Chemistry. Required of First-year students in the School of Medicine, open to Seniors in the School of Arts. Minor for the degree of A.M.
Mr. PELLEW
- IV *Experimental Inorganic Chemistry*—One exercise per week in the laboratory. Open to Sophomores, Juniors, and Seniors in the School of Arts
Dr. VULTÉ
- V *Chemical Physics*—Arranged as an introduction to the subsequent course in Chemical Philosophy. Synopsis of lectures: Matter—Motion—Force—Gravitation—Work and Energy—Properties of matter in the three states, the solid state, the liquid state, the gaseous state—Weighing and measuring. Recitations are held on the subjects treated of in the lectures, and numerous problems are discussed and solved in class. Lectures and recitations, two hours a week during the second term. Required of School of Mines First-year students, Course in Analytical and Applied Chemistry. Open to Seniors
Dr. WIECHMANN
- VI *Qualitative Analysis*—Lectures, recitations, and laboratory practice. The student is required to repeat all the experiments at his table in the laboratory. Having acquired a thorough experimental knowledge of the reactions of a group of bases or acids, single members of the group or mixtures are submitted to him for identification. He thus proceeds from simple to complex cases, till he is able to determine the composition of the most difficult mixtures. Two lectures, two recitations, and laboratory practice at

least ten hours a week throughout the year. Required of School of Mines First-year students, in the courses of mining, engineering, electrical engineering, metallurgy, geology and palæontology, and analytical and applied chemistry. Open to Seniors. Prerequisite or parallel: Course I. Text-book: Fresenius' Qualitative Analysis
Dr. WELLS and Mr. CUSHMAN

University Courses

VII *Chemical Philosophy. Elementary Course*—Synopsis of lecture-course: Introduction—Aims of chemistry and of chemical philosophy—Specific gravity of solids, liquids, and gases—Chemical nomenclature and notation—Atoms—Atomic mass—Valence—Molecules—Molecular mass—Structure of molecules—Stereochemistry—Chemical equations and calculations—Volume and mass relations of gases—Gas analysis—Solutions—Energy—Chemical Affinity—Thermal relations—Thermo-chemistry—Electro-chemistry. Stress is laid on a thorough understanding of the principles of stoichiometry, and the solution of numerous problems. In the second term, works on special divisions of theoretical chemistry are read and discussed in class. Lectures and recitations four times a week throughout the year. Required of School of Mines Second-year students in the course of analytical and applied chemistry. Minor for degree of A.M. and for first year for Ph.D. Text-book: Wiechmann's Lecture Notes on Theoretical Chemistry
Dr. WIECHMANN

VIII *Chemical Philosophy. Advanced Course*—History of chemical theory. Study of selected problems in theoretical chemistry. Lectures, conferences, and recitations four hours per week for one year. Text-books: Ostwald, *Lehrbuch der Allgemeinen Chemie*; Von Meyer, *History of Chemistry*; Lothar Meyer, *Modern Theories of Chemistry*. Minor subject for second year for Ph.D.
Dr. WIECHMANN

IX *Examination of New Methods of Qualitative Analysis.*—

Conferences and laboratory practice at least ten hours per week. Major for the degree of A.M.

DR. WELLS

- X *Spectroscopic Analysis*—Laboratory practice and conferences with the instructor eight hours a week throughout the year. Minor for degree of A.M.

Dr. WELLS

- XI *Special Chemical Reactions*—Conferences and laboratory practice at least ten hours per week. Major for degree of A.M.

Dr. WELLS

- XII *Quantitative Analysis*—Lectures, recitations, and laboratory practice. The student is required to execute in the laboratory a certain number of analyses in a satisfactory manner. He first analyzes substances of known composition that the accuracy of his work may be tested by a comparison of his results with the true percentages. He is then required to analyze substances whose composition is known only to the instructors. Two lectures and two recitations a week throughout the year. Laboratory practice not less than twelve hours a week throughout the year. Required of School of Mines Second- or Third-year students in the courses of analytical and applied chemistry, and metallurgy, and of Second-year students in mining engineering and geology. Major for the degree of A.M. Text-book : Cairn's Quantitative Analysis

Professor WALLER, Mr. BOWEN, and Dr. VULTÉ

- XIII *Special Volumetric Methods of Quantitative Analysis*—Conference and laboratory work at least eight hours a week. Major for the degree of A.M.

Professor WALLER

- XIV *Determination of Atomic Weights*—Conference and laboratory work at least eight hours a week. Major for the degree of A.M.

Professor WALLER

- XV *Quantitative Relations of the Rare Elements*—Conferences and laboratory work at least twelve hours a week for two years. Research. Major for the degree of Ph.D.

Professor WALLER

XVI *Qualitative Electrolytic Analysis*—Conferences and laboratory practice at least ten hours per week for two years. Research. Minor for the degree of Ph.D.

Dr. WELLS

XVII *Quantitative Electrolytic Analysis*—Conferences and laboratory work at least twelve hours a week for two years. Research. Major for the degree of Ph.D.

Professor WALLER

XVIII *Elementary Organic Chemistry*—This course comprises (1) Introduction to organic chemistry, including a historical review; (2) organic elementary analysis; (3) chemical structure of carbon compounds, including the theory of radicals; (4) empirical, rational, and structural formulæ; (5) classification of organic compounds; (6) decompositions and transformations of organic compounds. Lectures three hours a week throughout the year. Minor for the degree of A.M.

Professor COLBY

XIX *General Organic Chemistry*—This course comprises: (1) Ultimate organic analyses; (2) determination of physical properties of organic compounds; (3) general principles of synthetic organic chemistry; (4) laboratory preparations. Lectures and recitations six hours a week; laboratory practice at least twelve hours a week throughout the year. Prerequisites: the collegiate courses of the department, quantitative analysis, crystallography, physics, algebra, geometry, trigonometry. Required of School of Mines Fourth-year students, course in analytical and applied chemistry. Major for the degree of A.M. Text-book: Richter's *Chemie der Kohlenstoffverbindungen*; Levi's *Organische Praeparate*

Professor COLBY and Mr. WARD

XX *Advanced Organic Chemistry*—Minor Courses. Any two of the following subjects: (1) Metallo-organic compounds and their properties; (2) the terpenes and camphors; (3) discussion of the pyrrol and pyridin bases; (4) physical properties of organic compounds as related to their molecular constitution; (5) studies in thermo-chemistry; (6) synthetic alkaloids; and such other subjects as may be selected.

Lectures, conferences, and laboratory practice not less than twelve hours a week. Prerequisites : Course XIX, analytical geometry, calculus, and mechanics. Minor for the degree of Ph.D.

Professor COLBY

XXI *Advanced Organic Chemistry*—Major Courses. Any one of the following subjects : (1) Prehnitol and its derivatives ; (2) adipic acid and its formation from aromatic compounds ; (3) the substitution products of sulpho-benzid ; (4) investigations on cyan-acids ; and such other subjects as may be selected. Conferences and laboratory practice at least twelve hours a week for two years. Research. Major for the degree of Ph.D.

Professor COLBY

Department of Mineralogy

Collegiate Courses

I *Blowpipe Analysis*—As an introduction to mineralogy—conferences and laboratory work throughout one term, two conference hours and two afternoons per week. Open to Seniors

Professor MOSES and Mr. LUQUER

II *Crystallography*—As an introduction to mineralogy—lectures and conferences throughout one term, two hours per week. Open to Seniors

Professor MOSES

University Courses

III *Systematic Mineralogy*—Classification ; physical and chemical relations of species and groups ; critical study of some assigned group. Major subject, Ph.D. Nine hours per week, two years

Professor MOSES

IV *Physical Mineralogy*—General study of physical properties, with especial attention to : (a) measurement, methods of calculation, and delineation of crystals ; (b) optical characters, fundamental principles, and apparatus ; (c) optical

and crystallographic study of assigned species. Major for Ph.D. Nine hours a week for two years.

Professor MOSES and Mr. LUQUER

Courses II and III require previous knowledge equivalent to Course V.

- V *Descriptive and Determinative Mineralogy*—Study of 200 important species, their properties, uses, and methods of determination. Minor, Ph.D. Three hours per week, two years

Professor MOSES and Mr. LUQUER

- VI *Optical Mineralogy and Crystallography*—Designed as introductory to Major subject "Petrography"

Professor MOSES and Mr. LUQUER

Course V needs no especial preparation. Course VI requires the equivalent of Course VII

- VII *Optical Properties of Minerals*—Principles, apparatus, and distinguishing characters. Major subject A.M. Nine hours per week, one year

Mr. LUQUER

- VIII *Descriptive and Mathematical Crystallography*—General characters, laws, groups, measurement, calculation, and delineation. Major for A.M.

Professor MOSES

Course VII requires previous knowledge equivalent to Course IX. Course VIII needs no especial preparation

- IX *Course in Rock-Forming Minerals*—Study of 70 species with properties and methods of determination. Minor for A. M. Three hours per week, one year

Professor MOSES and Mr. LUQUER

Course IX needs no previous preparation. Courses V and IX, possibly also VIII, might be taken by students without full preliminary scientific training

Department of Astronomy

(A)—Collegiate Courses

- I *General Astronomy*—This course is historical and descriptive, and is supplemented by visits to the Observatory where students are taught to locate the principal constellations and are afforded opportunities to view the sun, moon, planets, nebulae, and stars. Lectures two hours a week for

one year. Reference books : Young's General Astronomy, Grant's History of Physical Astronomy, Clerke's History of Astronomy during XIX Century, and Clerke's System of the Stars

Prof. REES, assisted in the Observatory by Mr. MONELL

This course is open to Juniors and Seniors in the School of Arts

(B)—University Courses

II *Spherical and Practical Astronomy*—This course consists mainly in the study and use of the sextant for time and latitude determinations, and of the transit instrument for time. Lectures two hours a week for one year, supplemented by two hours a week in the observatory. Reference Book : Handbook of Practical Astronomy by W. W. Campbell

Prof. REES and Mr. MONELL

This course is open to properly qualified Seniors in School of Arts

III *Geodesy*—This course deals with the subjects named in the scheme of the Summer School in Geodesy. During the vacation between the first and second years of this course, the students are required to attend a summer school for six weeks to learn the use of apparatus, as follows

- A—1 Use of the Almanac for calculating elements needed in reductions
 2 Conversion of mean time into sidereal time and *vice versa*, and apparent time into mean time and *vice versa*
 3 Values of level divisions obtained by means of the "level trier"

B—Sextant

- 1 Construction of the instrument
- 2 Theory of the instrument
- 3 Adjustments
- 4 (a) Angle measuring
 (b) Time by single altitudes of sun employing artificial horizon
 (c) Time by equal altitudes of the sun—(art. hor.)
 (d) Latitude by single altitudes of Polaris (art. hor.)
 (e) Latitude by single altitudes of the sun (art. hor.)

(f) Latitude by circummeridian altitudes of the sun or stars (art. hor)

(g) Time by altitudes of stars

C—Transit Instrument, Clock, and Chronograph

1 Construction

2 Theory of instruments

3 Adjustments

4 Star lists and tables

5 Observations and reductions for constants and time error of clock

D—Base measuring

1 Construction of apparatus

2 Adjustments

3 Measurements of a base and reduction of observations

E—Angle measuring by “directions”

1 Construction of instrument

2 Adjustments

3 Observations and reductions

4 Night observations

F—Determination of the true meridian, and the azimuth of a line

1 Theory of methods

2 Observations and reductions

G—Barometric hypsometry

1 Construction of instruments

2 Adjustments

3 Formulæ and tables

4 Observations and reductions

Lectures for two hours a week for the first year, and two hours a week for the first term of the second year. Reference Books : Campbell's Practical Astronomy, Clark's Geodesy, United States Coast Survey Reports, and Jordan's Handbuch der Vermessungskunde

Prof. REES, Mr. JACOBY, and Mr. MONELL

This course is required of the Civil Engineers in the School of Mines and is open to properly qualified Seniors.

IV *Advanced Spherical and Practical Astronomy*—This course deals with the subjects of time, latitude, longitude ; use of equatorial telescope, and the like. Lectures two hours a

week for two years. Observatory work four hours a week for two years. Reference Books : Chauvenet's (two vols.) Spherical and Practical Astronomy, and Doolittle's Practical Astronomy

Prof. REES and Mr. JACOBY

Open to graduates only

- V *Theoretical Astronomy*—This course deals mainly with the theory of comet orbits and their calculation. Lectures one hour a week for two years, supplemented by computations. Reference Books : Klinkerfues' Theoretische Astronomie and Oppolzer's Bahnbestimmung

Mr. JACOBY

Open to graduates only

- VI *Theory and Methods of Reduction of Photographic Star Plates*—This course deals with the determination of star places from the photographic plates, and includes the subjects of stellar parallax and proper motion. Lectures one hour a week for two years, with practical work

Mr. JACOBY

Open to graduates only

Graduates pursuing Courses IV, V, VI, must satisfy the Instructor that they are qualified to pursue the studies. Such qualification, requires that Courses I and II, or I and III shall have been previously pursued, or their equivalent offered ; or in special cases Courses I and II or I and III may be pursued along with Courses IV, V, VI

Minor Courses for A.M. Degree

- (1) Course II without Observatory work
- (2) Course III for one year without summer school
- (3) Course IV (when qualified) without Observatory work, one year

Major Courses for A.M.

- (4) Course VI (when qualified) for one year.
Courses given above with Observatory work and summer school

Minor Course for Ph.D.

Course IV for two years with Observatory work

Major Courses for Ph.D.

Courses IV and V or IV and VI or V and VI for two years, and some selected work for original investigation

Department of Geology**(A)—Collegiate Courses**

I *General Geology*—First term : Cosmical Geology, involving a presentation of the nebular hypothesis ; Lithology, involving laboratory practice with rock collections ; Physical Geology, involving the discussion of folds, faults, mountain making, volcanoes, earthquakes, and water as a geological agent. Second term : Stratigraphical and Historical Geology, involving laboratory work with type fossils and collections illustrating local stratigraphy throughout the United States. Two hours a week throughout the year. Lecture and laboratory course. Text-book : LeConte's Elements of Geology

Mr. HOLLICK

(This course will be given if elected by six students.) Open to Juniors and Seniors

II. *General Geology*—A more elaborate discussion of the subjects mentioned under Course I. Three hours a week throughout the year. Lecture and laboratory course. Required of Third-year students in the School of Mines except in the courses of Architecture and Electrical Engineering. Open to Seniors. Not open to students who have taken Course I. Text-book : Dana's Manual of Geology
Professor KEMP

(B)—University Courses

III *Economic Geology*—First term : A discussion of the general features and formation of ore-bodies, followed by a description of the occurrence of the ores of iron, copper, lead, zinc, silver, gold, and the lesser metals, with especial reference to North America. Second term : A description of the distribution and occurrence of coal, petroleum, natural gas, asphalt, building stone, water-supply, salines, and minor minerals. Lectures and conferences four

hours a week throughout the year. Required of Fourth-year students in the School of Mines in the courses of Mining Engineering, Metallurgy, Chemistry, and Geology. Open to students who have taken Course I or II or their equivalent. Minor for the degree of A.M. Text-book : Kemp's Ore-Deposits of the United States, and lecture-notes privately printed

Professor KEMP

- IV *Petrography*—A description of the microscopic structure and mineralogical composition of the crystalline rocks, and a discussion of the origin of the igneous rocks; and of metamorphism. Two hours' lectures and four hours' laboratory work throughout the year. Required of Fourth-year School of Mines students, Course in Geology. Minor for degree of A.M., Prerequisite : Course IV, Department of Mineralogy

Professor KEMP

- V *Invertebrate Palæontology*—A general description of invertebrate fossils, following the biological sequence. Two hours' lectures and four hours' laboratory work throughout the year. Required of Third-year School of Mines students, Course in Geology. Minor for degree of A.M., Prerequisite : Course I, Department of Biology. Text-book, Nicholson's Manual of Palæontology

Mr. HOLLICK

- VI *Advanced Petrography*—Supplementary to Course IV, with an additional year of eight hours' laboratory work and reading. Minor for the degree of Ph.D.

Professor KEMP

- VII *Palæobotany*—Study of fossil plants, following the biological sequence. One hour lecture or conference and four hours' laboratory work throughout two years. Minor for degree of Ph.D. Prerequisite : Course I, Department of Botany. Text-book : Solms-Laubach's Palæophytology.

Mr. HOLLICK

- VIII *Petrography of the Serpentine in the Vicinity of New York*—Field and laboratory work. Not less than eight hours a week for two years. Major for the degree of Ph.D. Research

Professor KEMP

- IX *Geology of Restricted Areas in Eastern North America*—Field and laboratory work. Not less than eight hours a week for two years. Major for the degree of Ph.D. Research Professor KEMP and Mr. HOLLICK
- X *Petrography of Suites of Igneous or Metamorphic Rocks from Various Localities*—Field and laboratory work, not less than eight hours a week for two years. Major for the degree of Ph.D. Research Professor KEMP
- XI *Investigation of Some Series of Ore-Deposits*—Field and laboratory work, not less than eight hours a week for two years. Major for the degree of Ph.D. Research Professor KEMP
- XII *Study of the Flora of Certain Geological Horizons*—Field and laboratory work. Not less than eight hours a week for two years. Prerequisite, Course V, Department of Botany. Major for the degree of Ph.D. Research Mr. HOLLICK

Department of Biology

Collegiate Courses

- I *Elementary Zoölogy*—Introductory to Elementary Biology, Palæontology, Geology. (1) Outline of the rise of Natural History ; living authors. (2) Cellular basis and simple functions of life. Branches of Biology. Principles of Zoölogical Classification. (3) Systematic and descriptive course : Protozoöns, Sponges, Cœlenterates. Echinoderms, Vermes, Arthropods, Mollusks, Molluscoids. Vertebrates : Fishes, Reptiles, Birds, Mammals. (4) Influence of living organisms upon the earth's surface. (5) General principles, distribution, environment, evolution. Open to School of Mines students, one year. One hour a week. Lectures and demonstrations in the Museum. Text-book : Packard's Elements of Zoölogy
- II *Elementary Biology*—Introductory to Morphology, and Physiology, and to the General Principles of Biology. (1)

General Introduction. Unicellular organisms : Amoeba, Pleurococcus, Yeast, Bacteria, Infusoria, Transitional organisms, Spirogyra, Nitella. Multicellular organisms: Hydra, Hydroids. (2) Introduction to Invertebrate Zoölogy. Earthworm, lobster, crab, grasshopper, mussel, starfish. (3) Introduction to Vertebrate Zoölogy. The lancelet, dogfish, frog, tortoise, pigeon, and embryonic development of the bird (chick), rabbit. In this course the detailed study of a series of living forms is made the basis for brief discussions of the leading principles of general Biology. In addition the main problems of Evolution, Heredity, and the like are briefly explained. Open to Juniors, Elective. Two afternoons (four hours) a week throughout the year. Lectures and laboratory work. This course is designed for students of Geology, Psychology, Physiology, and Medicine, as well as for those who intend to pursue Botany or Zoölogy. Text-book : Huxley and Martin, *Practical Biology*. Reference book : Parker's *Elementary Biology*

Professor WILSON, Professor OSBORN

- III *General Zoölogy*—An introduction to advanced Ætiology, Morphology, and Embryology. (1) Natural environment, faunal areas, terrestrial and marine. Principles of faunal distribution. Geological succession of life, or Palingenesis. (2) Classification and general characters of the Chordata, fishes, amphibians, reptiles, birds, and mammals. Comparative study of nervous, vascular, alimentary systems, etc. Embryology : the development of the bird, amphibian, fish. Embryological technique. (3) Comparative Morphology, Classification and General Zoölogy of Invertebrates. Open to Seniors, Elective. Two afternoons (four hours) a week throughout the year. Lectures and laboratory work. This course is especially designed for students preparing for Medicine, for students of Palæontology, and for those who intend to pursue Biology. Text-books : Wiedersheim's *Comparative Anatomy* ; Foster and Balfour's *Elements of Embryology* ; Claus and Sedgwick's *Text-book of Zoölogy*

Professor OSBORN, Professor WILSON

- IV *Comparative Neurology*—An introduction to the comparative structure of the brain and nervous system of the lower and higher animals. Beginnings of nervous functions in the Protozoa. Nervous systems of hydroids, jellyfish, and starfish. Primitive vertebrate system in the lancelet. Evolution of brain, spinal cord, and nerves in fishes, amphibians, reptiles, birds, and mammals. Thorough examination of the brain of the sheep. Introduction to localization of functions. Open to advanced Seniors and graduates. One afternoon (three hours) a week throughout the year. In first term, lectures and laboratory work. A laboratory course in second term. Text-book : Edinger's Twelve Lectures upon the Nervous System ; also the works of Hertwig, Obersteiner, Romanes, and others
Professor OSBORN, Mr. STRONG.

University Courses

- V *Comparative Morphology*—General Anatomy and Organogeny of Vertebrates and Invertebrates, with special reference to the problems of Phylogeny and Classification. Training in anatomical and embryological technique. Required of candidates for Ph.D. degree in the first year. Lectures and laboratory work. Six hours (one day) a week
Professor OSBORN, Professor WILSON
- VI *Comparative Embryology*—Segmentation of the Ovum. Origin and differentiation of the germ layers. Origin and meaning of larval forms. General organogeny. The relations of ontogeny and phylogeny. Open to graduates. A lecture and laboratory course in 1893-4 and 1895-6, alternating with Course VII. Six hours (one day) a week. Reference books : Korschelt and Heider, *Entwicklungsgeschichte*, Hertwig, Balfour
Professor WILSON
- VII *Cellular Biology* (Cytology)—General morphology and physiology of the cell. Cell division. Maturation of the germ cells, fertilization, experimental cytology. Laws of cell growth. Open to graduates. A lecture and laboratory course in 1894, alternating with Course VI. Six hours (one day) a week. Reference book : Hertwig's, *The Cell*
Professor WILSON

VIII *Morphology of the Mammals*—A study of the structure and development of fossil and recent mammals. Classification based upon general anatomy and placentation. Main attention directed to comparative osteology, evolution of the teeth and skeleton. Facilities for research in the new collection of fossil mammals of the American Museum of Natural History. Open to graduates. Laboratory course in first term. Lecture course in second term, 1893. Six hours (one day) a week throughout the year. Reference books : Flower and Lydekker, *The Mammalia* ; Flower's *Osteology* ; Zittel's *Palæontologie*
Professor OSBORN

IX *Morphology of the Fishes*—The comparative anatomy of the fishes, recent and fossil. Study of the general morphology of recent forms. Marine faunæ and distribution. Research in the Newberry collection of fossil fishes, School of Mines. Open to School of Mines students, Juniors and Seniors in certain courses, and to graduates. Laboratory course in first term. Lecture and laboratory course in second term. Six hours (one day) a week. Reference book : Smith Woodward, *Catalogue of Fossil Fishes*
Dr. DEAN

X *Special Morphology*—Subject in 1893-4 : Morphology and interrelationships of the Platyhelminthes (Turbellaria, Trematoda, Cestoda, and Nemertinea). Anatomy, development, and classification. Nature and effects of parasitism
Subject in 1894-5 : The Protochordata. For graduates. One lecture a week. Second term
Mr. WILLEY

XI *Advanced Biology*—The study of special groups of animals or of special problems in Anatomy, Embryology, Cytology, Ætiology, as an introduction to original investigation. This course may include thesis work for the degree of Doctor of Philosophy and be pursued in connection with either of the Courses VI-X. Open to graduates, second or third year. Research and conferences directed by different members of the department, according to the nature of the subject selected. At least twelve hours (two days) a week

Department of Botany

Collegiate Courses

- I *Elementary Botany, Longer Course*—Study of Botany in its broadest sense, including introduction, vegetable anatomy, vegetable physiology, systematic botany in the biological sequence of the groups, morphology of the flowering plants, and a review of palæobotany. One hour lecture and four hours' (two afternoons) laboratory work. Text-book: Bastin's College Botany. Open to Juniors and Seniors. Professor BRITTON and Mr. CURTISS
- II *Elementary Botany, Shorter Course*.—Same as Course I, but with two hours (one afternoon) laboratory work a week. Text-book: Bastin's College Botany. Open to Juniors and Seniors. Professor BRITTON and Mr. CURTISS
- III *General Botany*—Description of the principal features of vegetable physiology and anatomy and of the principal characteristics of the sub-kingdoms and classes. Lectures, one hour a week. Text-book: Bastin's College Botany. Open to Seniors, except those who have taken Courses I or II. Required of First-year School of Mines students in the Courses of Chemistry, Mining Engineering, and Geology. Professor BRITTON
- IV *Vegetable Anatomy*—Study of the principal characteristics of vegetable cells and tissues. Two hours' laboratory work a week. Text-book: Goodale's Physiological Botany. Prerequisite: Courses I, II, or III, or their equivalent. Open to Seniors. Required of Second-year School of Mines students, Course in Geology. Mr. CURTISS
- V *Morphology and Determination of the Flowering Plants*—Dissection and examination of not less than 100 species of flowering plants selected by the professor, followed by a systematic study of types of the natural orders taken in biological sequence. Four hours' laboratory work. Text-books: Gray's Structural Botany and Manual of Botany. Prerequisite: Courses I or II, or their equivalent. Open

to Seniors. Required of Third-year School of Mines students, Course in Geology
Professor BRITTON

- VI *Economic Botany*—Description of drug-plants, food-plants, fibre-plants, and timber-trees, and other plants of economic importance and their products. Lectures, one hour a week. Open to Seniors. Prerequisite : Courses I, II, or III, or their equivalent. Required of Fourth-year students, Course in Geology
Professor BRITTON

University Courses

- VII *Cryptogamic Botany*—Description of the classes and principal orders of Protophyta, Thallophyta, Bryophyta, and Pteridophyta, with examination of types selected by the professor. One hour lecture and four hours' laboratory work throughout the year. Prerequisite : Courses I, II, or their equivalent. Text-book : Bennett & Murray's *Cryptogamic Botany*. Minor for degree of A.M.
Professor BRITTON and Mr. CURTISS
- VIII *Advanced Vegetable Anatomy*—Critical study of the cells and tissues of some plant or plants selected. At least four hours' laboratory work throughout the year. Text-book : De Bary's *Comparative Anatomy of Phanerogams and Ferns*. Minor for degree of A.M. Prerequisite : Course IV or its equivalent
Mr. CURTISS
- IX *The Natural Orders of Flowering Plants*—Study of the diagnostic characters of the orders in biological sequence. One hour conference and four hours' laboratory work. Reference books : Engler and Prantl's *Natürliche Pflanzenfamilien* and Baillon's *Histoire des Plantes*. Major for the degree of A.M. Prerequisite : Course V
Professor BRITTON
- X *Advanced Cryptogamic Botany*—Supplementary to Course VII. One hour lecture or conference and four hours' laboratory work throughout two years. Minor for degree of Ph.D.
Professor BRITTON and Mr. CURTISS

- XI *Comparative Study of the Tissues of not less than Ten Species of Plants of the Same Genus or Order*—Not less than eight hours a week for two years. Research, Major for degree of Ph.D.

Professor BRITTON and Mr. CURTISS

- XII *Collection, Determination, and Comparative Study of the Plants of Some Restricted Area*—Field and laboratory work. Not less than eight hours a week for two years' field-work during two summers. Research, Major for degree of Ph.D.
Professor BRITTON

- XIII *Critical Study of an Order or Genus of Plants of not less than Fifty Species*—Not less than eight hours a week for two years. Research, Major for degree of Ph.D.

Professor BRITTON

Department of Physiology

Collegiate Courses

- I *General Physiology*—The design of this course is to discuss the fundamental laws of protoplasmic action and to show how these laws operate in various animal types. The method followed throughout is the comparative one. So far as possible, the evolution of function is traced. The course serves as an introduction to the more technical Mammalian Physiology of Course II. For the present, no laboratory work is required. Lectures, one hour a week throughout the year. Open to Seniors, who have had at least one year's work in General Biology

Dr. LEE

University Courses

- II *Human Physiology as Related to that of Mammals and Lower Vertebrates*—The cell; growth; development; the chemical elements of the body; the proximate principles; the energy of the body; plant-life and animal-life; general sketch of the functions; the blood; respiration; the circulation of the blood; the lymph and its movement; secretion in general; digestion; the bile; absorption; some

phases of the metabolism of the body ; excretion ; muscle and nerve ; the spinal cord ; the brain. Lectures and demonstrations. Four or five hours a week throughout the year. Open to Seniors entering for the degree of M.D. ; as a Minor to candidates for the degree of A.M. ; and as a Minor, during the first year, to candidates for the degree of Ph.D. Text-book, none ; for reference, Foster's Physiology

Professor CURTIS and Dr. LEE

- III *Laboratory Work*—This is more especially in physical than in chemical physiology. A very complete equipment of apparatus is available, with provision for the speedy making of special pieces. Open to a limited number of candidates for the degree of A.M. or Ph.D.

Professor CURTIS and Dr. LEE

LABORATORIES

The Physical Laboratory

The Physical Laboratory consists of six rooms devoted to physical measurements ; some are arranged and used for optical and electrical purposes, others for special researches. The laboratory is supplied throughout with the street current of the Edison incandescent system, and all the ordinary conveniences. Among the pieces of apparatus the following may be specially mentioned.

For measurements of length there are three linear and three circular dividing engines of various designs ; a Geneva Society comparator, and dividing engine ; a Grunow cathetometer, spherometers, an optical lever, and micrometers of many kinds. For measurements of mass there are provided eight balances with weights, specific gravity apparatus, hydrometers, areometers, Westfall and Jolly balances, and the various forms of vapor-density apparatus.

Standard mercurial barometers, aneroid and Mariotti barometers, Kater's and Borda's pendulums, and apparatus for studying elasticity are provided.

Also a monochord, Quincke's apparatus, Kundt's dust-figure apparatus, and sets of organ pipes and tuning-forks for the study of sound.

Thermometers and apparatus for their calibration, and zero and boiling points, are supplied; also there is apparatus for determination of coefficients of expansion, for latent and specific heat, and calorimetry.

The optical rooms are furnished with eight spectrometers of different designs, small telescopes, opera glasses, microscopes, sets of lenses, prisms, and gratings, a goniometer, sextant, optical benches, photometers, saccharimeters, total reflectometers, and apparatus for colorimetry, polarised light, and spectroscopy.

In the rooms devoted to electricity are nine galvanometers of various patterns, high and low resistance, ballistic and dampened; electrometers, magnetometers, rheostats and bridges of all types; condensers, batteries, keys, arc and incandescent lamps, ammeters and voltmeters.

The work shop is furnished with a lathe, planer, grinding head, vises, carpenters' and machinists' bench, and tools for work in metal, wood, and glass.

Advanced students are taught and encouraged to repair, alter, and construct apparatus needed for their special work.

Chemical Laboratories

There are special laboratories devoted to the following branches of chemistry; a qualitative laboratory, a quantitative laboratory, an organic laboratory, and a laboratory for instruction in the principles of chemistry.

Laboratories of the Mineralogical Department

The work of the students in the college courses and in general mineralogy is performed in the Blowpipe Laboratory, a large room with conference tables and seats for about seventy-five men. In this room are the student collections of crystal models and minerals.

For the more advanced work the Department uses a smaller room equipped with section cutters and with tables for microscopic and goniometrical work. The instrumental equipment includes four lithological microscopes, four reflection goniometers, a magnificent Duboscq lantern with numerous attachments, three polariscopes a specific gravity balance and a small photographic outfit.

Astronomical Observatory

The Astronomical Observatory contains a set of portable astronomical instruments : a forty-six-inch transit, by Troughton & Simms ; a combined transit and zenith instrument for time and latitude determinations ; an equatorially mounted refractor of five inches aperture, to which is attached a spectroscope with the dispersive power of twelve flint-glass prisms of fifty-five degrees, by Alvan Clark ; also a diffraction spectroscope with grating, by L. M. Rutherfurd, Esq.

A set of comparison apparatus, with electrodes, Plucker's tubes, coils, etc., accompanies the spectroscope.

Instruction in practical astronomy is given in the observatory to students of the third and fourth classes in the Course of Civil Engineering.

By the gift of Mr. Rutherfurd there have been added to the observatory equipment : (1) An equatorial refracting telescope of thirteen inches aperture, supplied with a correcting lens for photographic work. With this instrument belong two micrometers for position measurements. (2) A transit instrument of three inches aperture by Stackpole & Brother. (3) A Dent sidereal clock. (4) A micrometer for measuring photographic plates, and sundry other pieces of apparatus. The observatory has a fine mean-time clock by Howard & Co., also chronographs by Fauth & Co., a personal equation machine, etc. The observatory and instruments are lighted by electricity.

Geological Laboratories

The Geological Laboratories occupy the basement and parlor floors of the dwelling-house No. 52 E. 49th st., but some study collections are of necessity kept in the lecture room and museum. The laboratories contain collections illustrative of the different kinds of rocks, and adapted to conferences in the course in general geology. There is also a much larger series of rocks embracing quite all the rarer species and structures, which are used for advanced work in microscopic petrography. Parallel series of thin sections are provided for these, as are microscopes and other necessary apparatus for study, instruction, and investigation. A machine for grinding thin sections of rocks, a photographic laboratory, and drawing facilities are at hand.

There are other study collections accessible to the students which illustrate the various geological formations and type fossils of the country, and which are used in the lectures and conferences on stratigraphical and historical geology. Still others are similarly employed in the lectures on economic geology. These latter are in the geological lecture room. The library of the late Professor Newberry is at present stored with the department and affords a quite complete series of geological reports and books of reference. In all the courses a large and continually growing series of lantern slides is employed in an electric lantern.

Biological Laboratory

The Biological Laboratory occupies the third floor of the Medical building upon 60th st., entrance on 59th st. It comprises a general laboratory for undergraduates, an advanced laboratory, a lecture room, museum and aquarium, a library in which the main collection of biological works from the University library is kept. This was founded by Mr. Charles H. Senff in memory of Dr. J. I. Northrop. The main features of the laboratory are the fresh-water and marine aquaria, the collection of marine alcoholic types from Naples and the Bahamas, and a full equipment of microscopes and optical instruments from Zeiss of Jena. (See also circular of the Department of Biology.)

Botanical Laboratory

The Botanical Laboratory is situated on the upper floor of the President's house. It is fitted up with tables and cases and is equipped with compound and dissecting microscopes and accessories and other apparatus for study and investigation. There is a large collection of microscopic preparations. The courses of instruction are illustrated by extensive series of models, charts, and lantern slides.

Physiological Laboratory

The Physiological Laboratory is in the College of Physicians and Surgeons building, in charge of Professor J. G. Curtis. It is fully equipped with laboratory facilities for research by a limited number of workers. The apparatus of precision required is furnished from the Swift Physiological Cabinet. This is a col-

lection of physiological apparatus of the latest models, by the best makers, given, together with provision for its increase, by the late James T. Swift, formerly a Trustee of the Medical School.

In the Medical building are also found the Museum of Human and Comparative Anatomy (Professor Huntington), the Laboratory of Physiological and Medical Chemistry (Mr. Pellew), and the Biological Laboratory (Professor Osborn).

MUSEUMS AND COLLECTIONS

Chemical Museum

There is a Chemical Museum containing nearly 8,000 specimens illustrating the chemical elements in the various forms in which they occur in nature as well as the compounds which they form with each other. In addition to this there is a collection of apparatus and instruments designed to illustrate methods of chemical analysis and methods of investigation into the chemical properties of matter. Organic chemistry is specially illustrated by two collections, one including the representatives of all groups of fatty chemistry, such as hydrocarbons, haloid ethers, oxygen ethers, alcohols, aldehydes, ketones, organic acids, acid anhydrides, amines, amic acids, amides, etc., aromatic hydrocarbons, halogen derivatives, phenols, aromatic alcohols, nitro bodies, azo bodies, derivatives of naphthalene, anthracene, phenanthracene, diphenyl, etc.

Collections of the Mineralogical Department

In February, 1864, Mr. Geo. T. Strong purchased and presented to the department a collection of 2,500 specimens belonging to Mr. Hale, editor of the *Commercial Advertiser*. From this as a nucleus there has been gradually developed by purchase, presentation, and exchange the present collection of about 26,000 labelled specimens. It now includes, in addition to the main collection, a large suite of pseudomorphs, a collection illustrating the physical characters of minerals, and a collection illustrating crystallography by natural crystals, showing both their normal and distorted forms. Arranged in wall cases are large specimens, showing the association of the minerals. There are also three separate student collections of average specimens, amounting in

the aggregate to over 6,000 specimens; and several thousand unlabelled specimens used in determinative work.

In addition to these collections the department also possesses collections of about 500 sections of minerals and at least 1,200 to 1,500 crystal models in wood and glass.

The collections of minerals presented to the department from time to time have usually been specimens selected by Professor Egleston according to the needs of the department, and paid for by the donors. A few gifts, however, have been made which are of a different nature and have historic value. In July, 1864, Mr. Gouverneur Kemble presented the Gillmore collection, made in Paris under the direction of the Abbé Haüy, and containing autographs of Haüy and Brongniart. In 1865 Mr. A. H. Almy purchased from the Sanitary Fair an exhibit of Schulsberg (Wis.) stalactites, and presented them to the department. In 1869 the Czar of Russia presented a magnificent suite of Russian minerals, which was wrecked off Fire Island, and later partly recovered. Duplicates of the missing specimens were sent. In Nov., 1870, Col. Moses presented the two finest cerussites in the world. In March, 1879, Messrs. Hoe, Pyne, Stuart, Hilton, and Depeyster presented the Julian collection of minerals from Chesterfield, Mass. In Dec., 1880, the famous collection of Prof. How of King's College, Nova Scotia, was presented by Messrs. A. H. & C. T. Barney, and last year a very valuable collection made in Japan by Dr. Egleston was presented by Messrs. Garland, Schermerhorn, Plume, and Cole.

A large number of gifts of one or more specimens have been made, and these, with the careful purchasing and exchanging, have resulted in a collection which fairly ranks as one of the two or three great mineral collections of this country.

The Geological Museum

Geology, Palæontology, Zoölogy

The Geological Museum occupies, together with the adjacent lecture room, the entire upper floor of the School of Mines building on Fourth avenue. It has been especially arranged for purposes of instruction, but displays in addition the larger, more valuable, and more interesting specimens. The largest portion of the museum is occupied by the collections illustrative of strati-

graphical geology and palæontology. They are arranged in floor cases and wall cases and are divided into three rooms, separated only by open arches, so that the Archæan and Palæozoic rocks are in one, the Mesozoic in another, and the Cenozoic in the third. In the tops of the floor cases the typical fossils and rocks are displayed, while in the trays of the closed cupboards under them the fuller series are stored. In the wall cases the stratigraphical sequence is indicated in the superposition of shelves, and explanatory charts are provided to indicate the general relations. There are several additional cases, containing specimens and models illustrative of physical geology, such as folds, faults, slips, volcanoes, and the Ward collection illustrating the stratigraphical succession of New York State. There is also a series of Ward's casts of large fossil skeletons. There are also several cases of the Palæozoic fishes, which include the types of the genera and species described by the late Professor Newberry. The museum contains as well a study collection of fossils, arranged on a purely biological basis, which is used to illustrate the lectures in palæontology and is always accessible to students.

In economic geology a most complete exhibition is made of the mineral resources of the United States, and in less degree of other lands. The specimens are arranged in floor and wall cases, the large ones being in the latter. They are grouped according to the economic products or metals that they afford. This collection is thought to be unequalled in its completeness, outside of the National Museum in Washington.

These collections are estimated at nearly 100,000 specimens. They were chiefly gathered by the late Professor Newberry, but accessions are continually being received.

The Herbarium and Other Botanical Collections

The Herbarium contains nearly 500,000 specimens, and is thus one of the largest in America; additions are at present made to it at the rate of about 20,000 specimens a year. It comprises (1) The collections accumulated by Dr. Torrey, which came into the possession of the college at his death in 1873. (2) The collections of Professor C. F. Meisner of Basle, Switzerland, presented to the college about the time of Dr. Torrey's death by Mr. John J. Crooke. (3) The collections of Dr. A. W. Chapman of

Appalachicola, Florida, presented by Mr. Crooke at the same time, containing the types illustrating Dr. Chapman's Flora of the southern United States. (4) The mosses of the late C. F. Austin. (5) The mosses of the late Dr. J. G. Jæger, recently acquired. (6) Miscellaneous accumulations since Dr. Torrey's death, now making up more than one third of the whole collection. The herbarium is rich in types of species described by Dr. Torrey, Professor Meisner, Dr. Chapman, Dr. Asa Gray, Mr. Austin, Professor Britton, and Dr. Morong. The various collections are now all arranged in a single series, but each sheet is identified by a designative label or stamp. There are also extensive collections of fruits, seeds, woods, and material illustrating economic botany, placed in cases and drawers.

LIBRARIES

The University library now contains about 150,000 bound volumes, and accessions are made to it at the rate of from 15,000 to 20,000 volumes annually. It is rich in serials and society publications. (The number of volumes classified under Pure Science is about 25,000.)

The library of the New York Academy of Sciences is also stored under the roof of the college library building although in a separate room of its own. It was begun in 1817 and contains the proceedings of most of the scientific societies of the world, which are and have been obtained by exchange. The files are especially rich in these. It is essentially a scientific library of reference. (About 10,000 volumes and bound pamphlets.)

The Astor Library and the Library of the American Museum of Natural History are also accessible. The former is particularly rich in serials, standard works upon all branches of science, and proceedings of learned societies. (About 60,000 volumes in science.) The museum library contains a full series of systematic works upon zoölogy besides a large collection of general works. (About 25,000 volumes.)

American Museum of Natural History

The American Museum of Natural History faces Central Park at 77th street. By an agreement between the Trustees of the college and of the museum, effected in 1892, qualified students of the college have access to the large exhibition and study collections under certain regulations. The museum is especially strong in the departments of geology, mineralogy, invertebrate palæontology, ornithology, and mammalogy. Recently a department of mammalian palæontology has been established under Professor Osborn, as curator, and extensive collections of fossil mammals are being made in the west. These will afford new materials for original investigations.

REGISTER OF STUDENTS

1892-3

CANDIDATES FOR THE DEGREE OF PH.D.

NAME	RESIDENCE	CITY ADDRESS
Edwin Mortimer Blake, E.M. University Fellow in Mathematics (Major) mathematical analysis (Minor) geometry, analytical mechanics	<i>Brooklyn, N. Y.</i>	(230 Washington ave.)
Joseph Albert Degh��e, Ph.B. (Major) chemistry (Minor) physics, botany	<i>Brooklyn, N. Y.</i>	(247 Harrison st.)
Harold Griffing, A.B. Major subject under the University Faculty of Philosophy (Minor) physics, biology	<i>White Plains, N. Y.</i>	
Charles Riborg Mann, A.M. John Tyndall Fellow (Major) physics (Minor) mathematics, astronomy	<i>Orange, N. J.</i>	
Edmund Howd Miller, Ph.B. (Major) chemistry (Minor) botany, and other minor subject under the Faculty of the School of Mines	<i>West Nyack, N. Y.</i>	
John Kunkel Small, A.B. University Fellow in Botany (Major) botany (Minor) biology, geology	<i>Lancaster, Pa.</i>	128 West 21st st.
Candidates for the degree of Ph.D.....6		

CANDIDATES FOR THE DEGREE OF A.M.

NAME	RESIDENCE	CITY ADDRESS
Harry Prosper Corser, Ph.B., M.S. (Major) physics (Minor) mathematics, chemistry	<i>New York City</i>	20 East 121st st.
Allison Emery Drake, Ph.D. Major subject under the University Faculty of Philosophy (Minor) biology, geology	<i>New York City</i>	328 West 145th st.

REGISTER OF STUDENTS

45

NAME	RESIDENCE	CITY ADDRESS
Parker Cairns McIlhiney, Ph.B. (Major) chemistry (Minor) physics, and other minor subject under the Faculty of the School of Mines	<i>Jersey City, N. J.</i>	619 Grand st.
Charles Percy O'Connor, B.S. (Major) chemistry (Minor) physics, and other minor subject under the Faculty of the School of Mines	<i>Brooklyn, N. Y.</i>	(149 Clinton st.)
Francis Pitt Smith, Ph.B. (Major) chemistry (Minor) physics, and other minor subject under the Faculty of the School of Mines	<i>Rye, N. Y.</i>	
Clark Greenwood Voorhees, Ph.B. University Fellow in Chemistry (Major) chemistry (Minor) botany, and other minor subject under the University Faculty of Political Science	<i>New York City</i>	59 East 75th st.
Albert Osborn Young (Major) chemistry (Minor) geology, and other minor subject under the University Faculty of Philosophy	<i>Tuckahoe, N. Y.</i>	
Candidates for the degree of A.M.7		

SENIORS OF THE SCHOOL OF ARTS PURSUING
STUDIES IN THE SCHOOL OF PURE SCIENCE

NAME	RESIDENCE	CITY ADDRESS
William Henry Bawden botany	<i>New York City</i>	115 West 78th st.
Joseph Bijur chemistry, mathematics, physics	<i>New York City</i>	41 West 53d st.
Charles Chisholm Brainerd physics	<i>Brooklyn, N. Y.</i>	(210 Penn st.)
William Ross Brinckerhoff botany, physics	<i>New York City</i>	63 East 79th st.
John Francis Carew physics	<i>New York City</i>	225 East 58th st.
Sidney Bernhard Cohn physics	<i>New York City</i>	12 East 75th st.
Peter Grant Cornell physics, botany	<i>New York City</i>	26 West 49th st.
Henry Edward Crampton, Jr. biology, botany, geology	<i>New York City</i>	256 West 121st st.
James Edward Davis astronomy, chemistry, physics	<i>New York City</i>	26 West 51st st.
William Ballou Donnell physics, botany	<i>New York City</i>	330 West 56th st.

NAME	RESIDENCE	CITY ADDRESS
Joseph Alexander Dunn chemistry	<i>New York City</i>	246 West 22d st.
Appleton Grannis chemistry	<i>East Orange, N. J.</i>	
Roland Palmer Gray astronomy	<i>New York City</i>	122 East 83d st.
Chauncey Boyd Griffiths physics	<i>Newark, N. J.</i>	(352 Halsey st.)
William Addison Hervey botany	<i>Rossville, N. Y.</i>	223 West 45th st.
Norman Gildersleeve Johnson physics	<i>New York City</i>	480 Mott ave.
Frederick Kaufman physics	<i>New York City</i>	11 East 66th st.
Harvey Roberts Kingsley physics	<i>New York City</i>	588 Fifth ave.
Arthur Charles Kletzsch chemistry, physics	<i>New York City</i>	34 East 60th st.
Wilfrid Lay astronomy	<i>New Rochelle, N. Y.</i>	
Leffert Lefferts astronomy, chemistry, physics	<i>Flatbush, N. Y.</i>	
Edward Peale MacMullen botany	<i>New York City</i>	521 West 161st st.
Leonard Beecher McWhood botany, physics	<i>Newark, N. J.</i>	(136 Pennsylvania ave.)
Walter Taylor Marvin astronomy	<i>New York City</i>	2099 Fifth ave.
Walter Herbert Merrill astronomy, chemistry, physics	<i>New York City</i>	129 West 72d st.
George Lawrence Myers botany, physics	<i>New York City</i>	21 West 46th st.
Thomas Pollock Peters physics, botany	<i>Brooklyn, N. Y.</i>	(83 Lee ave.)
Charles Louis Pollard botany	<i>New York City</i>	105 East 82d st.
Louis Victor Southack physics	<i>New York City</i>	444 Madison ave.
Andrew Varick Stout physics	<i>New York City</i>	35 East 67th st.
Starr Taintor astronomy, physics	<i>New York City</i>	230 West 59th st.
Albert Payson Terhune botany	<i>Brooklyn, N. Y.</i>	(479 Greene ave.)
Samuel George Fitzhugh Townsend mathematics, physics, chemistry	<i>New York City</i>	131 Fifth ave.

NAME	RESIDENCE	CITY ADDRESS
Frederic Edgar Underhill chemistry, astronomy, physics	<i>New York City</i>	170 West 76th st.
Herbert Treadwell Wade chemistry, physics	<i>New York City</i>	149 East 46th st.
Dana Clemmer Wells mathematics, chemistry, botany	<i>New York City</i>	46 Exchange pl.
William Peck Whyland physics, botany	<i>New York City</i>	54 West 50th st.
Seniors from the School of Arts.....37		

STUDENTS OF THE SCHOOL OF LAW PURSUING STUDIES IN THE SCHOOL OF PURE SCIENCE

NAME	RESIDENCE	CITY ADDRESS
Jerome Reynolds North geology	<i>New York City</i>	307 West 52d st.
Charles S. Miller botany	<i>New York City</i>	185 East 95th st.
Students from the School of Law.....2		

STUDENTS OF THE SCHOOL OF PHILOSOPHY PUR- SUING STUDIES IN THE SCHOOL OF PURE SCIENCE

NAME	RESIDENCE	CITY ADDRESS
George Wallace Hutchinson physics	<i>New York City</i>	904 Lexington ave.
Students from the School of Philosophy.....1		

SPECIAL STUDENTS

NAME	RESIDENCE	CITY ADDRESS
Oliver Durfee Clark biology	<i>Brooklyn, N. Y.</i>	248 Schenck st.
Bertrard Chase Hinman, Ph.B. chemistry, physics	<i>Brooklyn, N. Y.</i>	(273 McDonough st.)
Alfred Pell biology	<i>Highland Falls, N. Y.</i>	
Joseph C. Thompson biology	<i>Rosebank, Staten Island, N. Y.</i>	
Charles Sampson Williams, B.S. chemistry	<i>New York City</i>	150 East 28th st.
John Dutton Wright chemistry	<i>New York City</i>	904 Lexington ave.
Special Students.....6		

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UNIVERSITY FELLOWS FOR THE YEAR 1893-94

- GEORGE H. LING, University of Toronto, 1893. Mathematics.
 R. A. MILLIKAN, A.B., Oberlin College, 1891. Physics.
 HARWOOD HUNTINGTON, A.B., Trinity College, 1884. Chemistry.
 HERMAN S. DAVIS, A.B., Princeton University, 1892. Astronomy.
 HEINRICH RIES, Ph.B., Columbia College, 1892. Mineralogy.
 WILLIAM D. MATTHEW, Columbia College, 1893. Geology.
 ALBERT P. MATTHEWS, B.S., Massachusetts Institute of Technology, 1892. Biology.
 JOHN KUNKEL SMALL, A.B., Franklin and Marshall College, 1892. Botany.

ACADEMIC CALENDAR

- 1893—June 5—Examinations for admission begin, Monday.
 June 14—Commencement, Wednesday.
 Sept. 20—Examinations for admission begin, Wednesday.
 Oct. 2—First term, 140th year begins, Monday.
 Nov. 7—Election day, holiday.
 Nov. 30—Thanksgiving day, Thursday, holiday.
 Dec. 25—Christmas holidays begin, Monday.
- 1894—Jan. 6—Christmas holidays end, Saturday.
 Jan. 29—Mid-year examinations begin, Monday.
 Feb. 7—Ash-Wednesday, holiday.
 Feb. 10—First term ends, Saturday.
 Feb. 12—Second term begins, Monday.
 Feb. 22—Washington's birthday, Thursday, holiday.
 March 23—Good-Friday, holiday.
 May 21—Concluding examinations begin, Monday.
 May 30—Memorial day, Monday, holiday.
 June 4—Examinations for admission begin, Monday.
 June 13—Commencement, Wednesday.
 Sept. 19—Examinations for admission begin, Wednesday.
 Sept. 26—Matriculation and registration begin, Wednesday.
 Oct. 1—First term, 141st year, begins, Monday.

